

REMARKS

Claims 1-4, 6-10 and 11-40 are pending. Claims 16-39 have been withdrawn. Claims 1, 9 and 40 have been amended herein. The Office Action does not give weight to the limitations of the simultaneous formation of the birds' beak structure and the protective insulting film, and that the birds' beak is formed of the same thermal oxide film as the protective insulting film. In light of this assertion applicants have removed the limitation; "... wherein the bird's beak structure under the floating gate electrode is formed simultaneously with the formation of said protection insulating film..." and amended a second limitation to read: "...wherein the bird's beak structure is [formed from] the same thermal oxide as the protective insulating film..."

Applicants' Response to the Claim Rejections under 35 U.S.C. §103(a)

Claims 1-4, 7, 9-10, 12, 14 and 40 stand rejected under 35 U.S.C. 103(a) as being unpatentable over US 6544845 to **Yoo *et al.*** in view of US 6294430 to **Fastow *et al.***

Applicants respectfully traverse on the basis that: (1) not all the limitations of the pending claims are set forth in the combination of references; and, (2) both **Fastow** and **Yoo** teach away from the combination.

(1) The combined references do not teach a required limitation.

Applicants respectfully traverse on the basis that **Yoo** fails to teach or suggest the limitation of claim 1, 9 and 40 that "the gate insulating film is interposed between the substrate

and the gate electrode to have a substantially uniform thickness at the region under the gate electrode.”

In the currently outstanding Office Action, the Examiner asserts that Fig. 13 of **Yoo** is a disclosure that “the gate insulating film 503A is interposed between substrate 500 and the gate electrode 508B have a substantially uniform thickness at the region under the gate electrode.” Applicants note that this position had been set forth in the Office Action of June 19, 2003, referring to Fig. 13(b) and column 4, lines 40-45 of **Yoo**.

Column 4, lines 39-43 of **Yoo** states: “The peripheral circuit transistors include...a bird’s beak-free peripheral circuit gate oxide film on the integrated circuit substrate between the spaced apart peripheral circuit source and drain regions.” However, Figs. 11-13 of **Yoo** clearly illustrate in the method of manufacturing the non-volatile memory device, that thermal oxidation is performed simultaneously on both structures in the cell array and the peripheral circuit region ((a) and (b) of Fig. 11) after the floating gate 504A and the peripheral circuit gate 508B are formed. Since thermal oxidation is performed, a bird’s beak structure is formed under the peripheral circuit gate 508B of the peripheral circuit transistor (“the lower portion of the edge of the peripheral circuit gate 508B of the peripheral circuit region is thermally oxidized and rounded as shown in the circuit marked with the “R2” through the above-mentioned thermal processing.”(9:11-14)). Therefore, according to the manufacturing method taught by **Yoo**, the gate oxide film 503A formed under the peripheral circuit gate 508B is non-uniform and has a thicker part at each end adjacent to the oxide film 515 as shown in (b) of Fig. 13. The non-

uniform thickness remains as a bird's beak structure under the peripheral circuit gate 508B in the structure of **Yoo**.

This non-uniform thickness of the gate oxide film 503A is not a "substantially uniform" thickness as required by claims 1, 9 and 40. Wherefore, applicants respectfully submit that not all the limitations of the currently claimed invention are disclosed by the cited references and respectfully request that the rejection be withdrawn.

(2) The references teach away from the required combination.

The Office Action maintains that the two structure of **Yoo** and **Fastow** are combinable so as to result in a structure with the benefits of the **Fastow** device.

Specifically, the Office Action relies on **Yoo** for its disclosure of a flash/logic combination in which a birds' beak structure is formed in the region between the tunnel insulating film 502A and the floating gate electrode 504A, and for its disclosure of having side wall surfaces covered with a protection insulating film formed of an oxide 562. The Office Action admits that **Yoo** does not teach the limitation of a protective insulating film continuously covering the top and sides of the multilayer gate electrode structure uniformly.

The Office Action relies on the disclosure in **Fastow** for its teaching of a protective oxide layer 314 which covers the top and side surfaces of a gate stack 306. The Examiner maintains that one of skill in the art would find the combination obvious. Particularly, the Office Action asserts that the skilled artizan would combine the protective insulating film 314 of **Fastow** with **Yoo's** structure because the protective insulating film "... reduces the number of oxide traps in

the birds' beak region of the tunnel oxide thus improving the reliability of the floating gate memory device."

Under U.S. Patent law, a *prima facie* case of obviousness is not established if there is no teaching, suggestion or motivation to combine the references. Further, U.S. law maintains that motivation to combine cannot be maintained if there is a clear teaching away from the combination present in the cited references. See M.P.E.P. §2143.01. Applicants respectfully submit that in the current instance one of skill in the art would not be motivated to make the combination as doing so is contrary to the teachings of the references. Particularly, **Yoo** requires a thicker tunnel oxide film 502A/514; whereas, **Fastow** requires a thin tunnel oxide film 304.

Yoo teaches that a birds' beak area 518 thicker than the gate oxide film 502A is formed in the area in which the floating gate 504A overlaps with the source and drain regions 532. As seen in Fig. 13 of **Yoo**, the oxide film 514 which overlays the source /drain region is thicker than the oxide film 502A under the gate stack 550. This is a requirement of **Yoo**.

Yoo states:

... the overlap capacitance Cd of the drain region can be reduced by increasing the thickness of the insulating film intervening the floating gate 504A and the source/drain regions 532...(9:7-10)

Yoo further notes it is a primary utility of the invention to reduce the overlap capacitance Cd of the drain region. (9:44-50).

Fastow teaches the opposite, that the tunnel oxide 304 is thinner in the regions overlying the source/drain regions. **Fastow** discloses that the admitted prior art teaches "...the tunnel

oxide at the source end has been thickened...” which results in “differing erase characteristics” (6:3-14). **Fastow** teaches away from thicker ends of tunnel oxide and towards decreasing the oxide over the source/drain regions. Specifically, **Fastow** states:

...The oxide that forms underneath the layer 304 of tunnel oxide is also significantly less than that experienced in the prior art process... the less growth of oxide underneath the tunnel oxide results in a thinner tunnel oxide layer 304...(6:46-52).

The distinct teachings can also be seen in the process differences between **Yoo** and **Fastow**. **Yoo** teaches that side walls 562 are formed prior to ion implantation 570. Contrary, **Fastow** does not teach forming side walls prior to ion implantation 331.

In light of the above one of skill in the art would not combine the teachings of **Yoo** and **Fastow**. The benefit of **Fastow** requires a thin tunnel oxide with close proximity to the ion implantation of the source/drain. Contrary, the improvement in overlap capacitance of **Yoo et al.** requires thickening of the tunnel oxide, which is protected from ion implantation by side walls. Thus, the teachings of the prior art cannot be combined as they clearly teach away from each other.

Claims 6 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 6544845 to **Yoo et al.** and US 6294430 to **Fastow et al.** as applied to claims 1 and 9 above and further in view of US 6406959 to **Prall et al.** Further, claims 8 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 6544845 to **Yoo et al.** and US 6294430 to **Fastow et al.** as applied to claims 1 and 9 above and further in view of Applicant Admitted Prior Art

Amendment under 37 C.F.R. §1.111
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(APA). Since the rejection depends from the rejection of claims 1 and 9, by addressing the rejection of the parent claims as discussed above, applicants respectfully submit that the rejection of claims 6, 8, 13 and 15 are also addressed by nature of their dependency.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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